DOCUMENT RESUME

ED 042 795 TM 000 053

AUTHOR	Allen, Dwight W.; Gorth, William P.
TITLE	The Development of Randomized Achievement Monitoring. Third Annual Report.
INSTITUTION	Massachusetts Univ., Amherst. School of Education.
SPONS AGENCY	Charles F. Kettering Foundation, Dayton, Ohio.
REPORT NO	TM-NO-AR-3
PUB DATE	15 Dec 69
NOTE	26p.
EDRS PRICE	EDRS Price MF-$0.25 HC-$1.40
DESCRIPTORS	*Academic Achievement, *Attitudes, Behavioral Objectives, Computer Programs, *Course Objectives, *Feedback, *Measurement, Student Attitudes, Teacher Attitudes, Test Construction
IDENTIFIERS	CAM, *Comprehensive Achievement Monitoring

ABSTRACT

The unique character and needs of the Comprehensive Achievement Monitoring (CAM) system has led to the creation of new computer programs and new techniques. Thus, earlier manual strategies (which were subject to error) for the handling of the large banks of behavioral objectives and test items, have been supplanted by a three-phase computer program that stores the objectives and questions, prints out selected objectives and their associated questions for inspection and, finally, constructs and prints the monitor tests in ready-to-use form. The attitudes of students and teachers toward CAM are discussed in detail and a more complete report on this subject is being prepared. The arrangement of test items, chronologically (in terms of teaching order) versus random, does not appear to be a significant variable. The report concludes with a brief review of steps being taken to secure demonstrations of the CAM technique in a variety of situations, by involving individual teachers, schools, and state agencies across the country. (GS)

ED042795

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY

Project Comprehensive

Achievement

Monitoring

Technical Memorandum No. AR-3 December 1969

THIRD ANNUAL REPORT

by

D. W. Allen, The University of Massachusetts

and

W. P. Gorth, The University of Massachusetts

The research and development reported herein was performed pursuant to a grant from the Charles F. Kettering Foundation to the Principal Investigator, Dr. Dwight W. Allen, Dean, School of Education, The University of Massachusetts.

Additional information or permission to quote from this document or to reproduce it, wholly or in part, should be obtained from:

William P. Gorth, Director
Project CAM
School of Education
The University of Massachusetts
Amherst, Massachusetts 01002

LC 000 052
TM
+6

THIRD ANNUAL REPORT

Submitted to the Charles F. Kettering Foundation

Title: THE DEVELOPMENT OF RANDOMIZED ACHIEVEMENT MONITORING

Submitted by: The University of Massachusetts

Initiated by: Dwight W. Allen
Dean, School of Education

Date: 15 December 1969

TABLE OF CONTENTS

	Page
Overview	1
Invention	2
Objective and Question Bank Computer Program	2
Item-Free Ability Estimation	3
Research	5
The Attitude of Students Toward CAM	5
The Attitude of Teachers Toward CAM	6
Variables in the Monitoring Procedure	15
The affect of monitor question arrangement	15
Aptitude test scores as criteria for stratification	16
Usefulness of total test score	18
Demonstration	19
Demonstration Schools	19
Proposals for the Demonstration of CAM	20
Dissemination	22
Technical Memoranda	22
Professional Meetings and Speeches	22
Journal Articles	23
Appendices	
Technical Memoranda and Bibliography	
Participating Schools	
Teacher Interview and Student Questionnaire	
Materials about Comprehensive Achievement Monitoring Distributed During 1969	

The long range goal of the Project for Comprehensive Achievement Monitoring is to develop a new technique for the measurement of student performance in the classroom. To reach this goal extensive invention, research, demonstration, and dissemination have been necessary. The Third Annual Report will discuss the accomplishments of the Project in each of these areas. The major emphasis will be concerned with discussing the current level of acceptability of students and teachers of the CAM system. The success of the Project ultimately rests on the support from these two groups. The appendices offer a collection of detailed information about the publications, participants and research instruments of the Project.

Invention

Several of the tasks of the Project for Comprehensive Achievement Monitoring are unique to its organization. No other achievement testing program has comparable ones. To facilitate the accomplishment of these tasks the Project has had to invent new computer programs and new techniques. This section will briefly describe two inventions of the Project.

Objective and Question Bank Computer Program

One of the major features of the CAM is the need to have available a large number of behavioral objectives to describe the goals of a course and even a larger number of test questions to measure student performance of the objectives. Several manual strategies have been developed for the selection and duplication of the objectives and questions. Each of these strategies has improved these operations but none of them is without the serious limitation of constant errors occurring at each stage in the processes.

To overcome the problems in these operations the Project has developed a computer program which will perform the clerical functions of these operations while allowing the teacher or experimenter the flexibility to make the final choice of objectives and to assign them to the monitors.

The computer program operates in three phases. The

first phase will allow the Project to keypunch the questions and their associated objectives on computer cards. The computer cards can then be stored on a magnetic computer tape. The tape storage allows a large number of questions to be stored economically and prevents unwanted rearrangement of the text of the questions. The second phase of the computer program allows the teacher or researcher to request a preliminary listing of all of the possible objectives, and their associated questions, which might be relevant to a course. The list is printed out in a format which is easy to read and can be thoroughly studied. The third and final phase of the program allows the questions to be assigned to specific positions on specific monitor forms and prints the forms out in a format which can be used directly as tests along with the computer card required by the computer program used for analyses.

The computer program is the current solution to the problem of quickly and accurately storing, selecting and printing the CAM monitors. The necessary flexibility has been built into the program to allow its use in many courses. The accuracy of the computer ensures that the clerical tasks which are critical to the operation of CAM are performed without errors.

Item-Free Ability Estimation

CAM monitoring is a highly efficient and comprehensive methodology for measuring the achievement of groups of students on

specific performance objectives. The usefulness of the CAM in measuring individual student growth and achievement is not as highly developed. The number of questions which any one student is asked and can answer at each test administration is usually very small. The information about each student is therefore limited.

The Project is cooperating with several faculty members at the University of Massachusetts in the near future in an effort to apply a new technique called item-free ability estimation to gain more information about individual students. The originator of the statistics for the technique was G. Rasch but a similar, more general model has been developed by Birnbaum. The technique may allow CAM to estimate individual growth during the year.

Research

Comprehensive Achievement Monitoring relies very heavily on statistical techniques and recently developed tools in the field of educational measurement. CAM uses these ideas in a combination which has not been tried before. The result is potentially a powerful strategy for the evaluation of student achievement. However, the use of such new ideas necessitates investigating their characteristics and discovering the influence of different variables on the quality of the measures of achievement. The following section describes the results of several of the surveys and experiments performed during the last year.

The Attitude of Students Toward CAM

The student is an integral part of the CAM system. The repeated measurement of the students' achievement will continue to be valid and reliable only as long as the students make an honest attempt to answer the questions. To maintain student interest in the monitoring procedure and to utilize the information collected about an individual student, teachers are encouraged by the Project to involve students in the interpretation of the results and in the use of individual reports to direct their studying. Each student was asked, by the two-page questionnaire included in Appendix C, for his opinion about CAM. The mean of

the responses, for each course, was calculated. The results were encouraging in several ways, although there are areas identified by the students in which improvement is needed.

The mean student reaction to the general question, "I like to take CAM tests (13)," for the courses hovered around neutral. Although this does not register enthusiasm for CAM it does not indicate a general, strong dislike for a program which is primarily concerned with testing. The students identified as having performed in the upper third of the class were more positive than their classmates. The composition of the CAM tests used in the 1968-1969 school year covered the entire breadth of the course. A student with a lower ability may not have appreciated the importance of his improvement in the course and this developed a negative opinion of CAM as well as the course. In answer to the question "There aren't many things in this subject that are interesting (8)," the students reacted in a neutral way also.

Much of the usefulness of the CAM system to the student is directed away from the testing situation towards the interpretation of the individual computer reports. The students on the average were neutral with "A lot can be learned by just taking the CAM tests (3)" and slightly disagreed with "The CAM tests don't help me to know what I should study next (4)." Both

questions refer to the testing situation directly which may contain vestiges of the anxiety of a typical testing situation. It is not clear to students that they learn or are being prompted to recall or to try problems measuring aspects of their course. The positive aspect of the CAM procedures for the student is located in the use of the computer output. When asked "The computer report of my CAM tests helps me figure out what material I haven't learned very well (7)," the average response was more than slightly agree. The students are positive toward the use of the output and find it helpful.

The operation of the Project in the schools is good. The students are very positive in their reactions to "There is usually enough time to answer all of the CAM test questions (1)," and negative to "There are too many CAM tests given in this course (2)." The arrangements made in allocating time for testing and the frequency of testing (usually biweekly) are acceptable to students. It is important to students that the mechanics of the CAM system are smooth. One aspect which the students do not perceive as adequate is the turn-around time on the report of the CAM analysis as indicated by their neutral, on the average, to "I get my CAM test results back too late to do any good (14)." Either a local data processing system or a data communication system would greatly reduce the delay in returning the analysis to students.

One very positive opinion held by students is their confidence in the importance of the results to the teacher in planning lessons for the class. They reacted quite positively to "The CAM tests are good because the teacher can find out what the class needs help on (20)." One of the strengths of the CAM system is its ability to provide the teacher with information useful to planning the course. For the students to appreciate the value of the information to the teacher is a major accomplishment for CAM. A more complete report of these results is being prepared.

The Attitude of Teachers Toward CAM

Many different activities are necessary to the operation of CAM in the school. The classroom teacher is often the person who is responsible for the leadership in this operation. If someone else in the school has been made responsible for the management of the mechanics of the monitoring system the teacher is still the key figure in communicating the results of the CAM procedure to the students and must himself make use of the information in adjusting his teaching to the circumstances in student learning suggested by the CAM analysis.

An interview or a questionnaire was administered to each of the teachers involved with the Project last school year. The teachers were asked questions about their experience with the

preparation of materials for the CAM system, i.e., test questions and objectives. They were asked to describe the procedures they used in preparing the CAM monitors, scheduling students to the tests, administering the monitors to the students, and scoring and analyzing the CAM data. Further, and most important, is their reaction to the procedures. What they felt were the advantages and disadvantages of the periodic monitoring and what they felt were the students' opinions. The information gathered from the teachers is summarized in this section. It is intended to provide a picture of the current acceptability of the CAM system in the public schools as seen by the teachers.

The preparation of behavioral objectives is by far the most time consuming component of the CAM process. Teachers have generally spent a 4 to 8 week portion of the summer on this task. The results of the first year of objective writing has often been revised during the second year of operation. The revisions have often been in the domain of refining materials and deleting extraneous objectives and have not taken more than two weeks. Rarely, in the experience of the Project, has the set of objectives developed for a course not covered more than the amount of work possible by 90% of the students.

To facilitate the initiation of more schools into the CAM system the Project had attempted to collect at least an initial set of objectives for each of the major subject matter areas to the

elementary and secondary school levels. Many of the participants in the Project in the future will be expected to choose the assistants of the preliminary set of materials for monitoring. The Project has already experimented with the strategy of providing a set of objectives to teachers as a first approximation to the content of their course. The computer program for storing objectives will serve as a tool to facilitate the distribution of these materials.

The preparation of test questions for the CAM procedure has typically also been done during the summer. Exceptions to this rule are available, i.e., where a teacher systematically added both objectives and test questions to a cumulative file for the year and had to merely revise or organize them when the summer came. About 40 to 200 hours were used in the writing and editing of the test questions for a course. Often the teachers stated that they did not get repeated use of the questions which they would normally write for their usual testing program although they would spend an equivalent amount of time. The CAM system has not resulted in an increase in the amount of time. It requires that the materials be used many times which distributes the value of the teacher's efforts over more of the year and even allows the teacher to systematically use the materials from one year to the next. Although the writing must be performed at the same time so that all of the

questions are available for the monitors, benefits may be derived from this strategy because the teacher has a clearer picture of the structure and continuity of the course.

The Project has made the test question writing situation even more of reasonable step for the teachers in the schools by developing test question bank to measure student performance objectives. This procedure has proved useful in the schools. It is possible to begin CAM monitoring with a much smaller commitment of time from the teacher beyond the usual classroom duties. Several schools have already begun CAM monitoring by developing tests from the test questions in the test question bank.

The administration of the CAM monitors to the students is one of the purely mechanical operations of the system but in several ways is the most controversial. Teachers are asked to carefully hand a different test to each student in the class. Each test must be accompanied by an answer sheet which is accurately marked with the student's number, the CAM monitor form number, and the student's responses to the questions. The work is clerical and strategies are constantly being sought to minimize teacher time needed for this job. The most immediate solution has been to enlist the help of a teaching aid. The aid will typically spend 2 hours per test administration sorting and marking the answer sheets for about one hundred students. With this task taken care of, teachers

usually feel that the CAM system is easier to carry out than the usual classroom testing because of its regularity and the use of computers to score answer sheets. Also the use of many test forms at the same time eliminates the problem of cheating. Another positive characteristic of the administration is that it can be done during a class period. This makes the stystem comparable in the type of time allocation and much easier to arrange than the longer standardized tests.

When the teachers were asked to report about the likes and dislikes of their students towards CAM they described a broad range of characteristics and the students' reaction to them. The regularity of the CAM system is seen as a positive aspect of the Project by students because they know what to expect. The content of the monitors is known in general and their format is familiar to them after a few test administrations. The teachers describe the effect on the students by saying that the systematic organization seems to ease the tension which an unfamiliar exam or a final exam would create.

The teachers also report that the students are influenced in what they study by the CAM procedures in two ways. The first is to point out to the student the areas of the course where he must review before the end of the course. The areas are very specific for the CAM feedback directs the student to performance

objectives. The second is more unusual for a testing program. The students in some cases are prompted to study ahead in the course topics which have not yet been covered. The student has a repeated opportunity in the testing situation to test his skills and knowledge on new problems. The course therefore takes on a new dimension of interrelatedness because recently acquired competences can be used in related problem situations.

Teachers have very specific characteristics which they find advantageous about the CAM system. First, the information provided by the computer analysis of the longitudinal data serve the teacher as an important tool in evaluating the effectiveness of their own teaching. By pointing to performance objectives which the students have not learned adequately even after teaching the teacher is able to review these topics during the current year and modify his teaching and assignments during subsequent years. Second, CAM has a more unique feature of allowing the teacher to see the retention of the performance objectives by the student and to modify the course to refresh student comprehension in areas easily forgotten. The notion of retention should play an important part in the teacher's planning the structure of a course.

The combination of the first two advantages and the ability of the CAM system to pretest students' performance create the third advantage of the system for teachers. It allows the

teacher to systematically develop the curriculum for a course. Many of the teachers in the Project have significantly modified an old curriculum or made major second year changes in a new curriculum. Usual classroom testing can not match the CAM technique in this domain and teachers have used it in many cases.

The general change in most students' attitudes towards testing would be a fourth advantage for CAM. The easing of the pressure often caused by the usual testing situation is considered a positive contribution to the teaching-learning situation. The CAM monitoring allows the students repeated opportunities to demonstrate his performance. The CAM system also requires the students to remember material throughout the course which stimulates the student to really learn material because he will be expected to use it over and over again on the CAM monitors.

If the administration and the correction of the CAM monitors is carried out smoothly, a fifth advantage of the CAM system becomes the effective use of data processing equipment to support the teacher's work. The potential types of analysis open when the data are collected systematically and are available to the computer can greatly improve the effectiveness of teachers.

The disadvantages to the CAM system mentioned by the teachers include teaching to the test, some restriction of the teachers usual flexibility, too many tests, the lack of questions requiring

anything except recall, and not enough time to use the CAM information. Each of these criticisms is being considered in the future research and development for the Project. Interestingly enough, several of the criticisms of CAM are connected with the organization of the current school programs. Not enough time to use the analysis provided by CAM is a function of the allocation of time in the school. It reflects the lack of conviction in the worth of evaluation in the modern curriculum. For CAM to function at its most profitable level the use of many of the innovative ideas of the field of education will have to be brought into focus in the arrangement of priorities in the schools.

Variables in the Monitoring Procedure

The variables of monitor question arrangement, the prediction of classroom achievement, and the meaningfulness of total monitor test score were considered in experiments carried out during the year. The purpose of the experiments was to investigate the sensitivity of the monitoring procedure to certain variables which are usually thought to influence the quality of the information provided by CAM.

The affect of monitor question arrangement. The questions on CAM monitors might be arranged on a form in several different ways depending upon the criterion used in the assignment

of a question to a position on the form. The technique often used in test construction to assign items to positions is that of random assignment, i.e., randomly so that no systematic bias is introduced into the structure of the test. This technique has almost exclusively been used in the design of the CAM monitors so that subsequent analysis of results can be performed under the assumption of random assignment.

Teachers have expressed a concern for the possible discouragement which students may feel because of the lack of questions which they can successfully answer on any CAM monitor. They felt that by arranging the questions in the order in which the students were taught the material the question tested, i.e., chronologically that the students would have the satisfaction of finding questions which they could more often answer at the beginning of the monitor. They would therefore be less discouraged. A second more technical reason for arranging the questions in the chronological fashion is the possibility for the teacher to score the results himself and have a clear cut-off point after which the student would not be expected to know the answer to questions and before which he should have answered all of the questions. The answer sheet when corrected becomes a very readable and interpretable record of the students' performance. The student might even use the answer sheet as his summary of his achievement in the course.

The experiments to investigate the comparison between the achievement results for students taking the monitors with the randomly arranged questions versus those with the chronologically arranged questions are described in detail in TM-21 and TM-22. The conclusion reached in the context of two courses in high school mathematics is that the arrangement is not a significant variable in the context of the CAM monitoring procedure. This result encourages the schools to proceed with the use of tests in either a random or a chronological of questions. Informally gathered impressions of teachers suggest that the students usually can identify questions which they should be able to answer because they have covered the appropriate material in their class already. They merely go through the questions on the monitors and try at least all of the questions which they are able to answer because of their studying in class.

Aptitude test scores as criteria for stratification. Nine reference tests of cognitive ability, as discussed in TM-18, were administered during the beginning of the school year. Their usefulness in stratifying students into different monitoring groups was analyzed at the end of the year. The analysis consisted of a correlation of the nine ability scores with the posttest score on a test composed of a number of CAM test items measuring the entire content of the course. The correlations for the course are dis-

played in Table TM-22.2 and are all below 0.360. The correlation of this relatively low magnitude probably does not justify the expense of administering the aptitude tests singly. A step-wise regression was used to predict the final score from the nine ability test scores. Eight of the nine scores (the ninth not being significant) yielded a multiple correlation coefficient of 0.430. As a set, the nine cognitive ability tests chosen were only moderate predictors of posttest achievement and under normal circumstances do not justify the cost of administration and scoring for purposes of scheduling students.

Usefulness of total test score. It was initially hoped that the total monitor test score from period to period would provide statistically useful information about the progress of individual students. The analyses performed on the tests used last year in CAM monitoring indicate that total test scores of individual students should not be used in their present form without extreme caution. They are useful to teachers in a cumulative way to red-flag students who just are not progressing in their achievement in the course as well as to announce the presence of students who have essentially mastered all of the expected material.

Demonstration

One of the most potent techniques for persuading individuals or organizations to try an innovative practice is to show them an operational demonstration in a natural setting. This strategy has been used in many contexts besides education and is a popular idea in education. The Project for Comprehensive Achievement Monitoring has been actively seeking out opportunities to set-up demonstrations of the CAM technique in schools across the country. The search has taken two major forms. First, the Project has requested the participation of individual teachers or schools in the CAM procedure. Second, the Project has made specific proposals to various agencies at the state level to support a demonstration of the CAM monitoring technique in the evaluation of other educational projects or in the systematic design of a group of demonstration schools.

Demonstration Schools

Through a variety of ways the involvement of schools in the Project has steadily increased over the last three years. The schools participating in the project during the first year were entirely research oriented. The schools which have joined the Project of the succeeding years have accepted the CAM technique as a substantive tool in education which must be trial tested in the specific environment of their school. The increase in terms of

numbers of students, teachers, schools, and states involved in the CAM monitoring technique is very encouraging. The specific statistics for the different numbers involved are displayed in Table AR-3.1.

Proposals for the Demonstration of CAM

A major emphasis in the Project has been the preparation of proposals to several state agencies for extensive demonstrations of the capabilities of CAM in educational program evaluation and in the public schools. The New York State Department of Education, Division of Research and Evaluation, requested that a proposal be written to evaluate programs funded by the Urban Education section of the Department. The proposal has been submitted (TM-20) and discussions of specific work is in progress. A second proposal (TM-23) has been developed for the Commonwealth of Massachusetts. The goal of the proposal would be the establishment of a system of demonstration schools in the state which would serve to promote the use of CAM.

Table AR-3.1 Growth of Involvement in CAM Measured by Several Criteria for Three Years

Criterion	Number involved		
	1967	1968	1969
States	4	6	7
Schools	5	8	17
Teachers	16	23	75
Students	800	1100	2600

Dissemination

Dissemination has taken a broad spectrum of approaches to communicate to the educational community an awareness of CAM and to encourage its use.

Technical Memoranda

The Project has made a systematic effort to make its findings available to the people interested in the technical aspects of achievement. The series has grown steadily and is listed in Appendix D.

Professional Meetings and Speeches

Major presentations of the notions of CAM have been made at our professional meetings, three of which were national and the other state. The purpose of the participation of the Project in these meetings was to inform particular organizations of the potential of CAM monitoring to meet some of their goals. The organizations consisted of educational researchers, educational measurement specialists, and teachers of mathematics. The reception of the groups to the ideas of CAM was generally very supportive.

The state level meeting was the Annual Meeting of the Educational Research Association of New York State. The Pro-

ject cooperated with members of the State Department of Education in preparing an extensive manual describing in detail the operation of the Project. This guide is included in the appendix D. It was used as the basic reading for the day-long presession, whose objective was to train participants in CAM techniques.

In addition to the meetings described above, various members of the Project staff have had the opportunity to speak to various individuals and groups during the past year. The groups have included teachers' organizations in more than half a dozen states. Other occasions have brought the staff in front of audiences of state education department personnel of several states including New York.

Journal Articles

During the year six articles have appeared in published form. The purpose of four of these articles has been to describe the potential of the computer programs which have been developed by the Project. Another article was directed at the experimental results concerning concepts used in CAM. The last article was an overall description of the general goals and operation of the Project. During the coming year several more articles are planned.